EXISTING U.S. SEED INDUSTRY PRODUCTION PRACTICES THAT ADDRESS COEXISTENCE

Prepared by the American Seed Trade Association

June 2011

INTRODUCTION

Founded in 1883, the American Seed Trade Association (ASTA) is a trade organization representing more than 700 member companies involved in seed production and distribution, plant breeding and related industries in North America. Its mission is to enhance the development and movement of quality seed worldwide. For that reason, ASTA commissioned the preparation of this paper to describe how the seed industry employs a variety of tools to attend to the different circumstances of coexistence needed to meet market demands. The paper focuses on seed industry practices within the context of the agricultural value chain.

For the purposes of this paper, "coexistence" means the practice of growing, reproducing and handling seed products with different characteristics or intended markets with the goal of successfully achieving intended product integrity and maintaining the economic value of such products.

AGRICULTURAL COEXISTENCE

Coexistence in the seed industry encompasses a set of tools used by the agricultural value chain to manage the complexities of plant biology and seed production systems, overlaid with market driven demands. The movement of pollen through wind and insects; specific aspects of plant reproductive biology; possible presence of weeds in seed production fields; and equipment used to plant, harvest and transport seeds all need to considered. Building upon many generations of experience, coexistence involves agricultural best practices that bring the greatest benefit to all along the agricultural value chain from seed developers to farmers and from retailers to consumers — from field to fork.

The coexistence of various production methods is not a new concept to the agricultural community. In agricultural coexistence, there has never been a one-size fits all because each crop brings a new set of market factors and biology to be considered. Farmers are accustomed to producing different crops next to one another, such as waxy, white, dent, pop and sweet corn, hot and sweet peppers, conventional and biotech grains and cotton

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varieties with different fiber characteristics. Innovation in crop production using modern biotechnology, such as genetic engineering (GE), is only the latest production method to be introduced to agriculture.

Agricultural commodities that provide food, feed, fiber and fuel move through an extremely flexible system that enables product exchange or replacement to maximize efficiencies. Identity preservation is a system that preserves the value of a product throughout its production chain. Farmers use identity preservation to gain premiums when they market specialty crops (such as seed, organic or a particular variety) because they must achieve an agreed upon standard of quality and purity in their harvested product as driven by the needs of the marketplace. Historically, in specialized production sectors, the growers and the rest of the value chain take responsibility for meeting any quality standards for the product's market demand, often through contractual arrangements. Market incentives balance the benefit and the burden at the farm level. Therefore, quality standards that compel coexistence have been market driven and science-based, and reflect practices that are practical, achievable and economically feasible. Ultimately, though, the success of coexistence lies in the communication and cooperation along the value chain.

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Coexistence enables the marketplace to work. End users indicate their needs and preferences through the choices they make on the market. These demands drive the response of the marketplace by working back through the agricultural value chain all the way to the seed industry. Premiums and incentives determined by that market are provided to those along the value chain willing to take on the extra work and cost associated with the production of goods which result from identity preservation. Equipped with marketplace information considered with possible incentives, each segment of the agricultural value chain chooses which crops and what production systems they prefer to employ to bring products to all markets.

Quality standards are based upon market expectations and the limits of biological systems. Therefore, thresholds or tolerances are a component of seed quality standards. The marketplace has historically worked out how to address the tolerances and thresholds for commingling or adventitious presence (AP) through these quality standards. The agricultural

value chain responds by finding practical levels to work within to meet reasonable market expectations.

SEED PRODUCTION & COEXISTENCE

The U.S. seed industry is committed to bringing quality seed to farmers around the world. There is no substitute for quality seed, and the key to high quality seed is to maintain seed product integrity. Markets send signals to the seed industry about what kind of seed should be produced so that farmers can meet the needs of their customers and the general consumer. With high quality seed and new technology, farmers have more choice than ever before, and the selection of seed is the single most important factor they can control in their operations.

As an identity preserved product, seed must meet a set of quality standards driven by the market and based on science to achieve the varietal purity desired by that market. The concept is very simple – consumer wants are driven back through the agricultural value chain to the seed industry, a crucial starting point in delivering what the customer is demanding. Scientific information, research and new innovations are reviewed to develop the best quality management systems for coexistence. Exchange is encouraged along the value chain to understand what is practical and realistic for the value attached to any identity preserved product.

Seed companies are required to use truthful labeling provisions that allow them to market seed with quality information disclosed in the packaging. The U.S. Federal Seed Act (FSA) regulates the interstate shipment of agricultural and vegetable seeds. FSA requires that seed shipped in interstate commerce be labeled with information that allows seed buyers to make informed choices and that the seed labeling information and advertisements pertaining to the seed be truthful. National certification standards, coordinated by the Association of Official Seed Certifying Agencies (AOSCA), are primarily found at the state, rather than the federal, level. Seed testing methods must meet standards developed by the Association of Official Seed Analysts (AOSA) or the International Seed Testing Association (ISTA), which accredit national seed laboratories.

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Seed sold in the United States normally goes beyond the requirements of the Federal Seed Act. Seed quality standards for variety identity and purity establish a percentage of unintended

mixing of other seed varieties, called “off-types,” while maintaining product integrity. Additionally, government policies on Low Level Presence are key to setting realistic parameters for coexistence related to biotechnology, organic and conventional agriculture.

Third parties play an important role in the success of coexistence in seed production. AOSCA promotes and facilitates the movement of seed or plant products in local, national and international markets through the coordinated efforts of official seed certifying agencies acting to evaluate, document and verify that a seed or plant product meets certain accepted quality standards. State crop improvement associations (such as California Crop Improvement Association and Indiana Crop Improvement Association) and members of AOSCA provide local venues for cooperation and communication to develop industry standards based on those of AOSCA for local seed production and house tools with regional relevance useful in implementing a plan for coexistence. The U.S. Department of Agriculture (USDA) is available to provide seed product documentation under the Organisation for Economic Co-operation and Development (OECD) Seed Schemes for certain export markets. In addition, seed companies often times interact with grower associations or organizations that represent a value chain. These relationships encourage dialogue along the value chain about market demands and ways coexistence can best be obtained.

COEXISTENCE TOOLS OF THE SEED INDUSTRY

Seed companies, often through contractual arrangements with seed growers, have procedures in place to maintain a seed variety’s trueness to type and to reduce chances for commingling during each step of the seed production cycle. The industry employs a variety of tools to successfully manage coexistence and general seed production, including seed production practices and quality management systems, contracting, pinning, communication and cooperation.

Production Practices and Quality Management Systems

For all practical purposes, seed is a product of identity preservation and utilizes methods consistent with commercial practices along the supply chain. Coexistence management practices will be dependent on a number of factors including the crop, the region and the growing environment. Seed production requires greater physical purity than commercial agricultural production, and therefore necessitates more physical barriers to reduce the movement of pollen. Physical mixing is another important consideration. Care must be taken to

ensure that physical processes such as planting preparation, harvest, seed cleaning/conditioning and subsequent storage do not compromise either seed quality or integrity. These practices may be employed by the seed company directly, by growers contracted to produce the seed on their behalf, or a combination of the two entities. In seed production, a broad range of production practices may be employed or accounted for, and include:

- Intimate knowledge of neighboring crops and the wild plant communities for possible cross-pollination with seed crops;
- Farmer to farmer communication;
- Rotation schemes of crops which reduce pollen exposure from volunteer plants;
- Seed handling so there is no mixing during planting, harvesting and cleaning operations;
- Temporal isolation for pollen release through staged planting times;
- Field/plot selection and identification;
- Isolation distances, largely based on each crop's reproductive system (self- or cross-pollinated);
- Buffer rows;
- Tracking and recordkeeping;
- Pre- and post-harvest cleaning and inspection of planters, harvesters and other equipment;
- Module markers used in harvest;
- Disposal of plant material as appropriate;
- Designated or cleaned transportation vehicles, storage bins, conditioners and ginning facilities as appropriate;
- Continuous visual inspection and rouging of all genetic stocks to remove off-types and weeds;
- Fields inspections multiple times, possibly by third parties; and
- Post-harvest risk mitigation, such as not harvesting outside rows, if cross-pollination has occurred after planting.

A quality management system takes production practices used in coexistence and puts them into a structure. Quality standards are based upon market expectations and the limits of biological systems. Therefore, thresholds or tolerances are a component of seed quality

standards. Maintaining a seed variety's trueness to type is critical for market acceptance. Isolation and containment are used to strive for the greatest purity. A percentage of off-types are part of any practical quality standard at the different levels of seed production – breeder materials, seed stocks and commercial seed. The standard is tighter in the early stages of seed production (i.e. breeding). As seed production is ramped up and broadened, purity expectations are less stringent, but always mindful of the product integrity needed for commercial seed sales.

AOSCA seed standards may serve as the basis for any seed quality management system. The baseline standards of AOSCA have been in place for many years. They are based on pollen flow research conducted by universities with the best science at the time. AOSCA makes available to its members the *Seed Certification Handbook* (2009 is the latest edition). Although this handbook is available only to members, the certification standards are generally made public through the state crop improvement associations.

The seed industry uses the AOSCA standards as a minimum, and seed companies may increase their internal quality management requirements depending on the market or type of standard they are trying to meet. General measures are developed by the company into a quality management system for the variety of seed being produced and include identity preservation programs, grower training and inspections. These in-house procedures either meet or go beyond this base level depending on what the market dictates.

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The U.S. seed industry, through ASTA, has developed the *Guide to Seed Quality Management Practices* to offer general guidance for the development and production of seed products intended for use in food, feed, fiber or fuel and for the maintenance of product integrity and purity of both biotechnology-derived seed and non-biotechnology seed. The guide covers the plant product life cycle from the point of incorporation of a trait into a breeding program through commercial seed production and sale. The guide is intended to serve as a reference document for companies developing individual quality management practices and operating procedures. In determining how best to use this guide, companies should consider the needs of the marketplace and customer demands so that the appropriate practices and procedures become a normal part of the business process. The *Guide to Seed Quality Management Practices* is maintained in a dynamic and interactive format

on the ASTA website and can be found directly through www.amseed.org/seedquality. This interactive structure allows companies to easily refer to the entire guide or specific sections.

Quality Management Systems, such as ISO 9001, provide structure and rigor to business practices by way of managing key process variables, thereby establishing routine and consistent output from their processes. In addition, these systems facilitate coexistence among growers, meeting customer expectations and providing mechanisms for continual improvement of the quality management system. Tracking, recordkeeping, testing and other measures with appropriate oversight management systems are essential parts of product development and commercial life cycle for purposes of quality control and seed purity. An underlying consideration throughout any quality management system is the importance of communication with neighboring seed growers, farms and residences as appropriate. Since maintaining a seed variety's trueness to type is critical for market acceptance and use, robust quality management practices are needed for both biotechnology or non-biotechnology derived crops.

Contracting

Contractual arrangements with seed growers are an integral step in maintaining seed product integrity. Although the seed company contracts with the grower, the grower is normally responsible for the resolution of problems with neighbors. Contract terms with the grower may include:

- Specific instructions to reduce risk of off-types such as isolation distances, pollen rows and conditions (types of crops planted in previous years);
- Possible allowance for some modifications and use of post-harvest practices to reach standard requirements in the final seed lot;
- Contract requirements which include a stipulation of the purity standard the seed lot must meet;
- Previsions for the company to check the isolation distances such as buffers, border rows and weather effects; and
- Purity testing through either visual inspection or through genetic analysis, as well as post-harvest grow outs and bin inspections.

Contractual arrangements with seed growers are an integral step in maintaining seed product integrity.

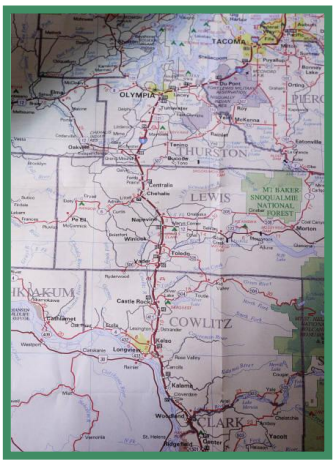
Corn seed production in the Midwest is a good example of the successful use of contracts to manage coexistence. In general, seed corn growers are required through contractual obligations

to meet minimum isolation distances requirements and other production practices. They are then responsible for the cooperation and communication among their neighbors to ensure any potential problems are prevented or minimized. If commingling should arise after planting through pollen drift, which jeopardizes the product integrity of the seed, there are measures a grower can take to deliver the final seed product within the contracted specifications. These corrective measures, such as not harvesting the outside rows for seed, would be part of an overall quality management system and outlined in the procedures and guidance given by a seed company to a contracted grower. Some companies choose to have a very close relationship with the grower and provide resources, support and machinery and have ongoing contact. Others contract with the grower, but are not in continuous, direct involvement with the actual production of the seed.

Specialty corn (white, waxy, pop, sweet) is a small portion of the total corn seed production, less than 10 percent. The quality standards are more rigorous with greater purity requirements (i.e. a lower level of off-types is permitted) and therefore require greater isolation distances. Because of these more rigorous quality standards, the contract grower for seed production of specialty corn will normally receive a greater premium which balances out the benefits and the burden on the farm through this market incentive.

Pinning Maps

In some geographic areas, the management of seed crop isolation distances is accomplished through pinning maps. The concept of “pinning” has been a coexistence tool of the seed industry for years. Every year there is a meeting, or “pinning party,” of those involved in seed production (at the state or a more regional level) to agree upon the geographic areas dedicated to different types of seed production and any other specialty crop production. A third party (a state crop improvement association or university Extension office) manages the map and log for the pertinent information. Pinning is not a legal arrangement but more of a “gentleman’s agreement” between companies, and generally, disputes are resolved without litigation.



In most states, a large wall-mounted map is housed at county Extension offices or at the state crop improvement association and is made available to growers and seed company representatives. Many different seed companies in a region come together and foster strong working relationships to create and maintain

isolation for seed production. Companies agree to seed quality standards and minimum distances based on buyer requirements. Isolation distances are agreed to by the seed companies based on topography, varieties, volunteers, weeds, insects and weather patterns.

Seed companies bear the responsibility for pinning. As a company signs contractual arrangements with seed growers, the location of each farmer's field is put on a map with a physical color-coded pin to represent the spatial and temporal isolation needed for its production. The pin indicates the exact site and date of planting a company will use for a particular crop and variety. Today, advances in software design, such as that by the California Crop Improvement Association, offer a secure Internet-based map pinning platform.

The parameters underlying the pinning maps can depend upon a number of factors. Isolation distances vary by density of insect pollinators, presence or absence of physical barriers, direction and intensity of prevailing winds and acreage planted to seed crops. Numbers of insect pollinators can increase based on ambient temperature, humidity and the agro-ecosystem. Physical barriers such as terrain, vegetation and buildings can significantly decrease the flow of pollen between crops and decrease necessary isolation distance. Prevailing winds and the physical size of the seed can also be important determinants in the amount of pollen present in areas adjacent to seed production plots. Cross-pollinated wind-pollinated species such as beets, Swiss chard and spinach require greater isolation than most other insect-pollinated cross-pollinators. Isolation from GE crops is important to organic producers and in other markets with low or no tolerance for biotechnology material.

Communication & Cooperation

The integrity of the seed industry and the products which they deliver is achieved collectively. Cooperation among seed developers, seed producers and growers at the local field level, particularly communication among neighboring growers, are necessary to sustain coexistence. Early communication is necessary so placement and contracting of fields can be accomplished in time for the seed production to begin. Third parties play an important role in this communication.

The spirit of cooperation creates the opportunity for ongoing dialogue when no crisis exists, building more trust among the parties and in the process itself. Growers are able to dissolve problems when they arise because of the cooperation they have built through the years. They may decide to change a field site, increase the isolation distance or select a planting date which decreases the risk of pollen flow.

EXAMPLES OF EFFECTIVE COEXISTENCE IN THE SEED INDUSTRY

Sorghum

Sorghum hybrids have been developed for value to the end user, such as grain and forage for ethanol and animal feed, sweet for use in syrup and food products and biomass for conversion into biofuels. Seed is produced for both the domestic and international markets.

In the mid-1950s the first hybrids were mainly focused on forage and grain sorghum for animal feed, and there was little experience with how vulnerable sorghum was to out-crossing and all the potential ways it could cross-pollinate. Through the years, with greater understanding, the seed certification process and requirements improved seed purity delivering the traits desired by the marketplace. This gave the customer more control of the inputs used for the end product – whether that is the farmer who is marketing the grain or the processor who is delivering a finished good for the consumer.

Although universities play a significant role in sorghum breeding programs, commercial seed production is handled by companies through contracts with farmers for hybrid seed production. The contracts which specify requirements and the adherence to quality control programs often go beyond the minimum requirements for seed certification and take into account the lessons learned about the production of hybrid sorghum seed:

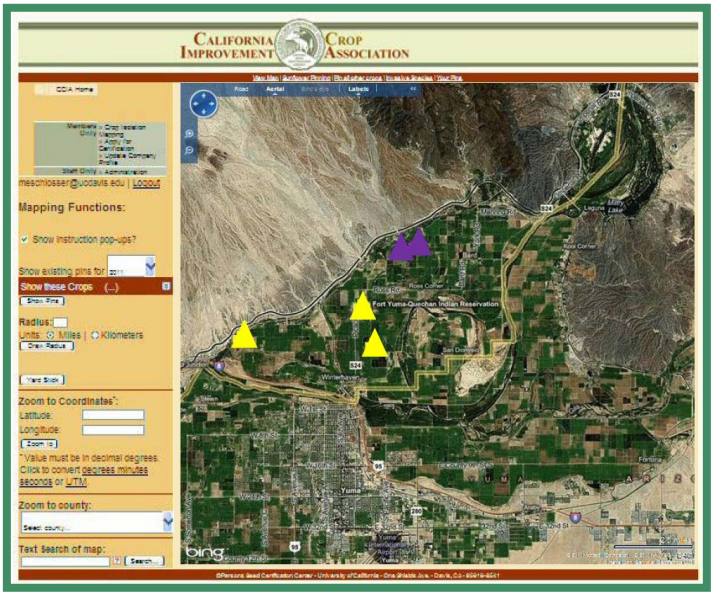
- Natural conditions, such as soil fertility, water, growing season, isolation and crop rotational capability;
- Field selection based on previous crop history and isolation distances;
- Quality of the growers, demonstrating good production management skills, cooperative neighbors and clean land;
- Rouging in the seed field and on adjacent land within the isolation distance to achieve limits on off-types;
- Proper cleaning of equipment used in planting, harvesting and crop management;

- Testing for quality, field identification and seed lot, sampling and handling, germination and winter grow-out; and
- Storage procedures to maintain seed quality and keep seed conditioned from moisture, temperature and insect damage, as well as lot separation.

Growers and seed companies meet each winter to discuss the next season's seed production and identify areas for forage and grain seed production. The growers receive contracts for their individual fields which are assigned numbers and then tracked through a data system to indicate which hybrid is being produced on each track of land. The farmers then have the responsibility to survey, establish and maintain the requirements set forth in the contracts and work with their neighbors. The seed company will perform audits, verify isolation distances and field quality, as well as use a variety of test methods to ensure the final seed meets the contract specifications. Provisions regarding final payment are spelled out in the seed production contract if the grower is unable to meet the contract specifications.

California

Seed production in California is broad, including canola, soy, cotton, alfalfa, sunflower, rice and many fruits and vegetables, through conventional, GE and organic production systems. The California Crop Improvement Association (CCIA) provides quality standards and seed certification for the many crops produced in the state. These quality standards act as a guide helping the pieces of the jigsaw puzzle fall into place so that all of these crops and their production systems can coexist, to deliver quality seed and value to the marketplace.



CCIA has taken the physical map and pin system and designed an Internet platform for seed representatives and growers to better cooperate, plan and coordinate their coexistence. Permission to access the Isolation Map platform is assigned by CCIA to a company who then is responsible to assign permission to an individual within the company. Each company then has access to view maps of certain crops

based on their profile. To place a pin, there is the option to locate a specific field through latitude and longitude coordinates, county, or by text entry (such as a city or park name). Navigation functions provide both zoom and movement around the map to find the desired location, and other pins can be shown or hidden. Other tools help measure distances and set up a desired radius.

Each crop is assigned a different kind of pin. Pins placed by the company logged into the map will be in yellow, while other company pins are displayed in purple. A plot is drawn out on the map and then the field information is entered for the pin, which includes the crop, variety, type of seed (certified, commercial, foundation, hybrid, parent or registered), status (pushed, which means planting is intended, or signed, which means the field is planted), the number of acres and the date the field was planted. Pins of other companies will provide the same information but not the specific variety. A warning is displayed if the new pin does not concert with the isolation distances of another pin. If the pin receiving a warning is still placed, an email is sent to the other parties involved.

Even with the evolution of an online map, other tools of coexistence are critical to the success of pinning, such as meetings to facilitate communication and cooperation, contracts that outline the desires of the marketplace and quality management systems that are put into practice.

Alfalfa

Alfalfa seed is produced for many different markets. In 2005, with the deregulation of Roundup Ready alfalfa (RRA), the first GE trait in alfalfa, coexistence practices were adopted by the industry based on pollen mediated gene flow studies conducted by a collaboration of industry and university scientists, and consultation with state seed certification officials. When sale of RRA was suspended in 2007, pending a court ordered USDA Environmental Impact Statement, the National Alfalfa & Forage Alliance (NAFA) brought together a range of stakeholders in a Coexistence Summit to re-examine the current stewardship program and the efficacy of such programs on protecting sensitive markets.

The case of alfalfa seed production demonstrates how the seed industry, along with the broader value chain, can cooperate to find solutions through good communication, scientific approaches and practical quality management measures to facilitate coexistence even in some of the most difficult market challenges.

A NAFA coexistence steering committee commissioned several work products coming out of this summit: a peer-reviewed scientific paper summarizing the multiple alfalfa gene/pollen flow experiments; NAFA Best Practices for RRA Seed Production; and coexistence documents

outlining strategy for specific AP-sensitive alfalfa hay/seed markets. The center piece was the science-based NAFA Best Practices for RRA Seed Production, which formalized the existing pollinator-specific isolation requirements for new RRA seed production acres, and added an annual AOSCA third party efficacy review. The isolation requirements were designed to meet an AP threshold of less than or equal to 0.5 percent, deemed adequate by the industry to service most domestic markets. California alfalfa seed growers produce most of the alfalfa seed destined for export markets. A more restrictive three mile isolation requirement for new RRA seed production plantings and additional restrictions for planting RRA in the Imperial Valley (the largest alfalfa seed production area in the U.S.), were implemented specifically to address the importance of this sensitive market.

Although different export markets have different and evolving seed quality requirements, most companies are testing all exported seed lots to a “non-detect” standard. To supplement this results-based testing, in 2010 AOSCA introduced a process-based certification process, called the Alfalfa Seed Stewardship Program (ASSP), designed specifically to meet typical alfalfa export seed market requirements. Working with industry, AOSCA built upon the existing standards for alfalfa seed production and added more robust measures, such as more inspections to verify the process.

NAFA is in the early stages of organizing Alfalfa Seed Grower Opportunity Zones (GOZ) which facilitate groups of growers to choose a focus on GE or AP-sensitive seed production – enabling some concentration and segregation of seed production of these two seed classes. To the extent that these GOZ help seed companies meet isolation and market seed quality standards, seed growers may demand a market premium for their production.

A second tool for concentrating and segregating acres is the California Crop Improvement Association hosted virtual national pinning map showing the location of GE and ASSP seed production acres. This map will allow seed companies to benefit from clustering new seed production around existing GE or AP-sensitive fields.

NAFA Best Practices for RRA Seed Production, AOSCA’s ASSP program, Grower Opportunity Zones and the alfalfa seed production pinning together provide substantial tools for coexistence of these various products. Seed growers, working with seed companies, NAFA and AOSCA helped organized these efforts in the spirit of cooperation and in the interest of the industry as a whole. By working together, they provide seed growers choice in the crops they produce and

possibly gain a premium for seed that meets standards put forth by the markets of value-added seed.

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FUTURE

The seed industry responds to the marketplace to deliver high quality seed in a multitude of crops utilizing a variety of production systems. As consumer preferences change, new innovation, technology and science are applied to the existing tools utilized by the U.S. seed industry to ensure the success of coexistence. New tools and the evolution of proven techniques, such as pinning or contracting, allow seed companies to best respond to what the market signals, providing appropriate financial incentives to those who take on the risk and work associated with the production of this specialty crop, seed. The dynamic nature of agriculture is apparent in today's seed industry, poised to supply high quality seed desired by all customers of food, feed, fiber and fuel.

RESOURCES

American Seed Trade Association Guide to Seed Quality Management Practices. General guidance for the development and production of seed products for the maintenance of product integrity and purity of both biotechnology derived seed and non-biotechnology seed, covering the stages of plant product life cycle from the point of incorporation of a trait into a breeding program through commercial seed production and sale. More information can be found at www.amseed.org/news_seedquality.asp

Association of Official Seed Certifying Agencies. The Association of Official Seed Certifying Agencies (AOSCA) sets out the minimum standards for seed purity and seed identity. It also recommends minimum standards for seed quality for the different classes of certified seed. More information can be found at www.aosca.org.

California Crop Improvement Association. California Crop Improvement Association (CCIA), a non-profit corporation, is officially recognized as the seed certifying agency under the California Seed Law. The mission of CCIA is to provide services and support research that

promotes the improvement, production, distribution and use of superior quality seeds and other agricultural products. More information can be found at http://ccia.ucdavis.edu/.

Federal Seed Act. Under the Federal Seed Act (FSA), the United States Department of Agriculture (USDA) Agriculture Marketing Service (AMS) regulates the interstate shipment of agricultural and vegetable seeds. The FSA includes several definitions of seeds by class, Breeder, Foundation, and Commercial, as well as labeling requirements. More information can be found at www.ams.usda.gov/lsg/seed/geninfo.htm.

International Seed Testing Association. The International Seed Testing Association (ISTA) develops and publishes standard procedures for sampling and testing of seeds. ISTA also runs an accreditation program. More information can be found at www.seedtest.org.

National Alfalfa & Forage Alliance. The National Alfalfa & Forage Alliance is an alliance between the growers, genetic suppliers and university segments of the alfalfa and alfalfa seed industry. More information can be found at www.alfalfa.org.

Organization for Economic Cooperation and Development Seed Schemes. The Organization for Economic Cooperation and Development Schemes for the Varietal Certification of Seed Moving in International Trade (OECD Seed Schemes) promotes the use of agriculture seed of consistently high quality. Certified seeds are produced - and officially controlled - according to common harmonized procedures in 58 participating countries. More information can be found at www.oecd.org/agr/seed.